

Scale Model Icing Research Tunnel



Scale Model Icing Research Tunnel (SMIRT).

NASA Lewis Research Center's Icing Research Tunnel (IRT) is the world's largest refrigerated wind tunnel and one of only three icing wind tunnel facilities in the United States. The IRT was constructed in the 1940's and has been operated continually since it was built. In this facility, natural icing conditions are duplicated to test the effects of in-flight icing on actual aircraft components as well as on models of airplanes and helicopters. IRT tests have been used successfully to reduce flight test hours for the certification of ice-detection instrumentation and ice protection systems. To ensure that the IRT will remain the world's premier icing facility well into the next century, Lewis is making some renovations and is planning others. These improvements include modernizing the control room, replacing the fan blades with new ones to increase the test section maximum velocity to 430 mph, installing new spray bars to increase the size and uniformity of the artificial icing cloud, and replacing the facility heat exchanger.

Most of the improvements will have a first-order effect on the IRT's airflow quality. To help us understand these effects and evaluate potential improvements to the flow characteristics of the IRT, we built a modular 1/10th-scale aerodynamic model of the facility. This closed-loop scale-model pilot tunnel was fabricated onsite in the various shops of Lewis' Fabrication Support Division. The tunnel's rectangular sections are composed of acrylic walls supported by an aluminum angle framework. Its turning vanes are made of tubing machined to the contour of the IRT turning vanes. The fan leg of the tunnel, which transitions from rectangular to circular and back to rectangular cross sections, is fabricated of fiberglass sections. The contraction section of the tunnel is constructed from sheet aluminum. A 12-bladed aluminum fan is coupled to a turbine powered by high-pressure air capable of driving the maximum test section velocity to 550 ft/sec (Mach 0.45). The air turbine and instrumentation are housed inside a fiberglass nacelle. Total and static pressure measurements can be taken around the loop, and velocity and flow angularity measurements can be taken with hot-wire and five-hole probes at specific locations.

The Scale Model Icing Research Tunnel (SMIRT) is undergoing checkout tests to determine how its airflow characteristics compare with the IRT. Near-term uses for this scale-model tunnel include determining the aerodynamic effects of replacing the 52-year-old W-shaped heat exchanger with a flat-faced heat exchanger. SMIRT is an integral part of the improvements planned for the IRT because testing the proposed IRT improvements in a scale-model tunnel will lower costs and improve productivity.

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